

ON A CHARACTERISTIC SOMATIC MODIFICATION INDUCED BY ADVERSE ENVIRONMENTAL CONDITIONS IN *DROSOPHILA*

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It has long been known that the time interval required for the metamorphosis of cyclorrhaphic Diptera, which is constant under standard conditions and characteristic for each species, varies considerably with changing environmental conditions. The variations of this interval with temperature have been investigated repeatedly and found to be of the same order of magnitude as the rate changes of many other biological processes with temperature changes.

The fluctuations in time required for the metamorphoses of these insects, induced by such agents as scarcity of food, are of a different order of magnitude than either those due to temperature variations or genetic differences, and are generally much larger. In our own experiments we were able to extend the time required for a complete cycle from egg to imago in *Drosophila* to 55 days, as compared with the average time of 9 to 12 days required under favorable conditions (20 to 50 larvæ per pint bottle of corn meal-molasses-agar-yeast culture at 26° C.). The effect is definitely proven as due to lack of food by collateral experiments in which larvæ were reared on filter paper to which a measured amount of food was added at intervals in the form of known quantities of yeast cells. Experiments with infected cultures, where the growth of *Aspergillus Penicillium*, or bacteria interferes with the multiplication of yeast cells, are of lesser value, because the fly larvæ consume mycelia, spores, and bacteria in large quantities and in this way overcome to some extent the scarcity of yeast food. Furthermore larvæ fed on such abnormal diet produce imagos showing various types of morphological abnormalities other than the one reported below.

The most convenient method next to that of rearing flies on

filter paper is that of increasing the number of eggs set out to hatch in a given culture. In a test series made by this method it was found that the average length of time required for metamorphosis was roughly proportional to the egg density in culture at the start.

At very high egg densities (over 2000 eggs per culture) a small percentage of individuals completed metamorphosis in normal time, another small fraction with a small delay, while about 90 *per cent* lived abnormally long as larvæ, some as much as 60 days, or longer than the normal average life span of *Drosophila* (*cf.*, Crozier and Enzmann, 1937). Such long-lived larvæ were slowed down in their development and cell differentiation. Thus the first instar and all the internal changes which ordinarily take place within 12 to 24 hours after hatching from the egg, were found delayed for as long as 2 weeks. During the later instars the underdevelopment of the fat body was the most conspicuous sign of lack of nutrition. If the larva pupated at all both pupa and imago were abnormally small.

Superficially the emerging flies were normal and they produced offspring of normal size and structure. A closer examination however revealed that nearly half of all flies produced after a period of metamorphosis exceeding 30 days had abnormal eyes.

The abnormality is a characteristic and constant feature and consists of the destruction of the normal hexagonal pattern of the facets, a diminution of facet number leaving irregular empty spaces on the eye rim, and finally the production of a number of abnormally large facets of deep red color. The term "blistered eye" has been applied to this peculiar somatic modification.

We are at present unable to give an explanation of the processes which lead to the production of blistered eyes. The deep red color of the enlarged facets in wild stock, as compared with the lighter red in normal-sized facets, suggests that the process of their formation is similar to the formation of "twin-spots" in *Drosophila* eyes (Haskins and Enzmann, in press), which is probably due to non-disjunction or similar processes as has recently been discussed by Jones (1937) who investigated twin spotting in *Zea mays*. The enlargement of the facets in our starved flies suggests polyploidy. In the somatic mosaics of diploid and tetra-

ploid cells described in plant material by many observers, the tetraploid cells are often found to be of larger size. No definite statement can be made regarding polyploidy in blistered eyes until chromosome counts are available.

The problem is of sufficient importance to be investigated further. Two points especially need further research: (1) does artificial delay of otherwise relatively rapidly dividing cells induce a tendency to chromosomal aberrations in other forms where direct examination of the chromosomes is easy and rapid; (2) would it be possible to induce the blistered eye modification by such an agent as colchicine, which is known to induce polyploidy in plant material?

LITERATURE CITED

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